FOOD-GETTING BEHAVIOR AS A FUNCTION OF DOMINANCE-DISTANCE IN FOUR MONGREL DOGS

An abstract of a Thesis by
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Food-getting behavior as a positive function of dominance-distance in two female and two male mongrel dogs was assessed in paired-feeding situations. The dominant subject was defined as the subject which gained access first to a food hopper in paired food-getting situations. Six unique pairings of the four subjects were conducted to determine the dominance hierarchy for the group. Each pair was fed in random order three times and each subject was fed alone nine times. Dominance-distance was defined by the formula $S_i - S_j$ where i and j referred to ordinal indices denoting a subject's rank in the dominance hierarchy; a dominance-distance of $\underline{0}$ indicated the trials in which a subject was fed alone. The trial sessions were conducted in a cage by delivering one unit (9.2 gms) of food to a small, single-access, feeding tray. The data failed to support the hypothesis that food-getting behavior increases as dominance-distance increases, although a slight trend in the hypothesized direction did emerge. One subject elevated her status from being the most submissive subject to being the second most dominant subject during the trial sessions. Dominance-distance as an important, but little understood, variable was discussed as a possible factor in increased conflict in territorially compressed groups. The method limitations of this project were also discussed.

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Chapter 1

INTRODUCTION

In a review of the literature on dominance, Van Kreveld (1970) noted that some researchers have commented that social closeness between members of a dominance hierarchy was accompanied by more interaction between these members than when the social distance was relatively large. Van Kreveld theorized that more encounters may be necessary to settle dominance relations between members when the social distance is small than when it is large. The influence of social closeness, or dominance-distance, seldom has been systematically studied although different types of behaviors (i.e. conflict or agonistic behavior, dominance-reversal behaviors, etc.) have been observed as possibly varying as a function of social closeness (Alexander, 1961; Clark, Kessler, & Dillon, 1973; Ewing, 1967; James, 1951; Kimbrell, 1969; Logan, 1971; Van Kreveld, 1970).

A methodological problem encountered in conducting research projects on social behavior is that interaction is so complex and subtle that precise and reliable data are difficult to obtain (Kimbrell, 1969; Plotnik, King, & Roberts, 1965). This study was designed to assess the effects of social closeness, or dominance-distance, on food-getting behavior in four mongrel dogs. Food-getting behavior is of interest because it provides a discrete

objective variable sensitive to the presence of a second individual in many species and, in particular, in the subjects selected for this study (James, 1951; Zajonc, 1965).

Dominance

Some general characteristics of dominance behavior are that the dominant-subordinate relationship is usually settled in the first few encounters through non-lethal aggression or displays of force. Once established, the relationship is very stable with few reversals. Any revolts are suppressed when the initial cues for dominance are displayed, resulting in social hierarchies that are established and maintained with a minimum of lethal injury to the members of the group (Van Kreveld, 1970). Since dominance is basically established and maintained through combat and displays of aggression, agonistic behavior, or behavior displayed in social confrontations, has often been the focus of study. Widely differing species have been reported to alter their agonistic behavior as dominance-distance decreases.

Dominance-distance has been defined (Kimbrell, 1969; Van Kreveld, 1970) as the difference in rank between two members of a dominance hierarchy, or $S_i - S_j$ where i and j refer to ordinal indices denoting rank. Thus the dominance distance between the most dominant member of a hierarchy, or S_1, and the third most dominant member, or S_3, would be

$S_1 - S_3$ or -2. Similarly, the dominance-distance between the fourth and tenth members would be $S_4 - S_{10}$ or -6.

Kimbrell (1969) researched the relationships between upright agonistic posture and dominance-submission following foot-shock situations in male mice. Changes in upright agonistic posture were reported to be an increasing linear function of dominance-distance in the same situation. The results indicated that as dominance-distance increases, upright agonistic posture in male mice decreases. The only member of a pair that did not display this trend was the most submissive subject who almost never exhibited any agonistic behavior at any time. Kimbrell discussed these results in terms of ambivalent behaviors occurring as a result of the shock situation. Kimbrell speculated that perhaps both attack and flight behaviors are aroused when the shock is presented. Further, the behavior of each member of a pair is, to some degree, under the control of the other member. It would be expected that about the same amount of posturing would be observed in both members when they are equal in dominance status. Flight tendencies are mutually stimulated by the posturing that occurs. When the dominance-distance between members is relatively larger, the flight tendencies are predominant in the submissive member and are further stimulated by the posturing of the dominant member.

Some breeds of dogs have been reported to show a greater incidence of fighting when close together in a

dominance hierarchy. James (1936) investigated conditioned salivary responses as a function of dominance in part-bassethound, part-German Sheperd dogs. He commented that greater conflict occurred between those members close together in the social hierarchy. In a later study on the social organization of beagles and terriers, James (1951) reported that little conflict occurred between the members at the top of the dominance hierarchy with those at the bottom, but that there was a great amount of conflict between the dominant terriers. These findings confirm the hypothesis that dominance-distance is a variable in social behavior.

Dominance-distance has also been found to be an important variable in the behavior of some insects. For example, Alexander (1961) reported that aggressive encounters between field crickets are usually more severe when they are evenly matched in dominance status. In fact, if the crickets are unevenly matched, they usually will not even fight. Ewing (1967) reported similar results with cockroaches.

Social Interaction

Although forms of agonistic behavior have been the most frequently reported behavior patterns in connection with social closeness, other types of social behavior have been reported to vary. Van Kreveld (1970) summarized a study by Plotnik, King, and Roberts (1965) in which social interaction in squirrel monkeys was observed. In the first

experiment four squirrel monkeys were housed together for two weeks and then individually trained in a food-getting situation. After each subject met the criterion, test trials were conducted which were identical to the training trials except that the subjects were kept together as a group. Between trials seven social interactions were recorded before starting the next trial. The forms of social interaction were pulling, pushing, biting, mounting, and genital display. Experiment II was an avoidance paradigm conducted in the same apparatus and interactions were again recorded. When the data from both experiments were combined, there were 1855 recorded occurrances of interaction with 1827 in the direction of the more dominant subject to the less dominant subject. Of interest is that the greatest frequency of interaction occurred between subjects adjacent on the social hierarchy, i.e., those which had a dominance distance of $\pm$ 1. Members which had a dominance distance of $\pm$ 2 between them displayed more social interaction than the members which had a dominance-distance of $\pm$ 3.

Dominance Reversal

Dominance-reversal was found in one study to occur most often between members with a small dominance-distance. Clark, Kessler, and Dillon (1973) investigated social dominance in squirrel monkeys over a twelve month period of time. Three pair-wise dominance tests were conducted at six month

intervals such that test I occurred at the start of the project, test II six months later and test III six months after test II. Comparison of the dominance ranks obtained in the three test sessions indicated a highly stable dominance hierarchy. Six of the ten subjects changed positions with the subject adjacent to it on the hierarchy. The maximum change in rank was made by two subjects who moved four positions each in the hierarchy.

Avoidance

Logan (1971) also reported data which emphasized the role that dominance-distance may play in social hierarchies. Logan grouped rats into high-dominance, medium-dominance, and low-dominance groups based on the degree of dominance they exhibited. To determine dominance, short pulses of electric shock were delivered to a pair of rats until one member displayed aggressive responses and the second member assumed a defensive posture. Once dominance was determined for a pair, the submissive member was paired again with a naive rat. If the naive rat was submissive, it was placed third on the hierarchy. If it was dominant, it was paired with the dominant member of the pair to determine its relative status. This progressive paired-comparisons procedure was conducted for forty-five rats which were then divided into five groups based on a dominance-submissive continuum with the most dominant, most submissive, and the intermediate group being

formed in this manner. The subjects were then paired and several instrumental responses, e.g., avoidance, escape, aggression, and total number of responses, were measured as a function of the subjects' dominance position. Logan found that the greater the dominance-distance, the less the dominant subject engaged in either avoidance or escape responding.

Hypothesis

While only a few researchers have investigated or commented on dominance-distance as a factor influencing social behavior, the paucity of observations may merely mean that dominance-distance has not caught their attention as a separate variable worthy of study. This project intends to focus on dominance-distance as a distinct variable in food-getting behavior in dogs. The study was designed to test the hypothesis that as dominance-distance increases, food-getting behavior increases.

Chapter 2

METHOD

Subjects

The subjects were two male and two female mongrel dogs obtained from the Des Moines Dog Pound. They had been maintained together in a much larger group of dogs for an indeterminate period of time. The subjects were individually housed in the Drake University Psychology Laboratory for the duration of the experiment. All of the subjects were judged by the experimenter to be full-grown, young adults. S_1, a female, weighed 13.15 kilograms; S_2, a female, weighed 14.06 kilograms; S_3, a male, weighed 14.06 kilograms; and S_4, a male, weighed 16.32 kilograms.

Apparatus

The home cages in which the subjects were housed were identical rectangular metal structures with dimensions of 76.20 cm. x 76.20 cm. x 101.60 cm. They were made of galvanized metal with wire mesh for the floors, roof, and upper half of the sides. Waste was removed via a sliding pan under the floor of the cages.

The experimental apparatus was a cage with similar dimensions as the home cages and located in a separate room. The experimental cage had solid sides and back, but was otherwise identical to the home cages. A 7.62 cm. x 2.54 cm.

metal tray served as feeding pan. A metal food chute outside the cage permitted the experimenter to dispense a small amount of Purina Lab Chow to the subjects at any time. The average weight of the units of food dispensed was 9.2 gm (standard deviation 1.1 gm). A rectangular piece of cardboard covered the wire mesh top of the experimental chamber. A 45.72 cm. x 45.72 cm. opening was cut from the cardboard and a one-way mirror was placed over the opening so the subjects could be observed without being distracted by the experimenter.

Procedure

The subjects' vocal cords were sectioned one day after their arrival in the Psychology Laboratory to avoid distracting other experimental subjects housed in the laboratory. The subjects were maintained and fed in their home cages for two weeks to allow adaptation to the laboratory environment. For the first three days of the adaptation period, 400 gms. of Purina dog chow was left overnight in the home cage of each subject. This was increased to 700 gms. on the fourth day as the subjects would consume 400 gms. in twenty-four hours. Individual exercise periods of ten minutes were conducted each morning.

A pre-experimental phase was conducted after two weeks in order to determine the dominance hierarchy of the four subjects. Each subject was deprived of food for

twenty-four hours prior to commencing this phase. Following this, the subjects were released as a group into a large room each morning and evening. A single tray containing 400 gms. of dog chow was placed on the floor. The first subject that ate was judged dominant for that trial, removed from the group, and placed in its home cage. The second subject to eat was judged second most dominant for that trial, removed from the group, and placed in its home cage. This procedure was also conducted for the remaining two subjects. Following this, each subject would have free access to food for fifteen minutes in its home cage. This procedure was repeated at 9 a.m. and 9 p.m. daily until the same dominance hierarchy emerged in two consecutive sessions.

The experimental phase was conducted to assess the effects of dominance-distance on food-getting behavior. The experimental phase consisted of eighteen sessions on eighteen consecutive days with one pair of subjects fed together and two subjects fed alone each day. Table I lists the order in which the subjects were fed. Each pair was fed together three times during the experimental phase and each subject fed alone nine times. Six unique pairs of subjects were obtained by pairing each subject with each other subject. The pairs were randomly assigned to the trial sessions.

A unit of food was delivered through the feed chute of the experimental chamber on a variable intertrial interval

TABLE I

ORDER OF PAIRED-FEEDINGS

Session	Paired-feedings	Individual Feedings
1	Dogs 1&3	Dogs 2,4
2	" 1&4	" 2,3
3	" 3&4	" 1,2
4	" 2&4	" 1,3
5	" 1&2	" 3,4
6	" 2&3	" 1,4
7	" 2&4	" 1,3
8	" 2&3	" 1,4
9	" 1&3	" 2,4
10	" 2&3	" 1,4
11	" 2&4	" 1,3
12	" 1&2	" 3,4
13	" 1&3	" 2,4
14	" 3&4	" 1,2
15	" 1&4	" 2,3
16	" 1&2	" 3,4
17	" 1&4	" 2,3
18	" 3&4	" 1,2

of sixty seconds if the previously delivered food had been consumed. If no food was eaten for five minutes, the day's session was ended.

Chapter 3

RESULTS

The primary measure of dominance was the number of units of food consumed by each subject when paired with each other subject and when fed alone. Dominance-distance was defined by the formula $S_i - S_j$ where S_i represents the rank of the dominant subject and S_j represents the rank of the subordinate subject. A dominance-distance of 0 indicates the trials in which the subject was fed alone.

The dominance order which emerged in the pre-experimental phase, in order from the most dominant to the most submissive, was S_3, S_4, S_2, and S_1. The criterion of determining dominance order during the pre-experimental phase, which was defined as the same rankings on two successive trials, was met on trials 16 and 17 of the pre-experimental phase.

Neither S_1 nor S_2 ate during the first two trials of the experimental phase. One subject, S_1, was a paired member on the first trial and fed alone on the second trial while S_2 was fed alone on each trial. Thus, familiarization trials were conducted for all subjects on the third day of the experimental phase. All subjects were fed to satiation, defined as not eating for five minutes, and S_1 was left in the experimental chamber overnight with fifteen units of food. This familiarization trial was conducted since S_1 had not

eaten during the first two trials. S_1 consumed all of the fifteen units of food prior to the experimenter's arrival the next afternoon. Each subject was again fed alone to satiation in the experimental apparatus on the fourth day. Data was collected from the fifth through the twenty-third day of the experimental phase. Table II shows the units of food consumed by each subject during the experimental phase.

During the experimental phase, another dominance hierarchy emerged as S_1 elevated her status from the most submissive subject to the second most dominant. The dominance hierarchy during the experimental phase, in order from the most dominant subject to the most submissive subject was S_3, S_1, S_4, and S_2. This was the same dominance hierarchy that occurred in the post-experimental phase and which was used for the data analysis.

Figure 1 shows the mean units of food consumed by each subject at each level of dominance-distance for that subject. It can be seen from Figure 1 that each S_j had four levels of dominance-distance, indicated by M_{i1}, M_{i2}, M_{i3}, M_{i4}, in order from the lowest to highest level of dominance-distance. It can also be seen from Figure 1 that the range of dominance-distance was from 0 to +3 for S_3, -1 to +2 for S_1, -2 to +2 for S_4, and from -3 to 0 for S_2.

The values $\bar{X}_{.1}$, $\bar{X}_{.2}$, $\bar{X}_{.3}$, and $\bar{X}_{.4}$ were obtained by formulas:

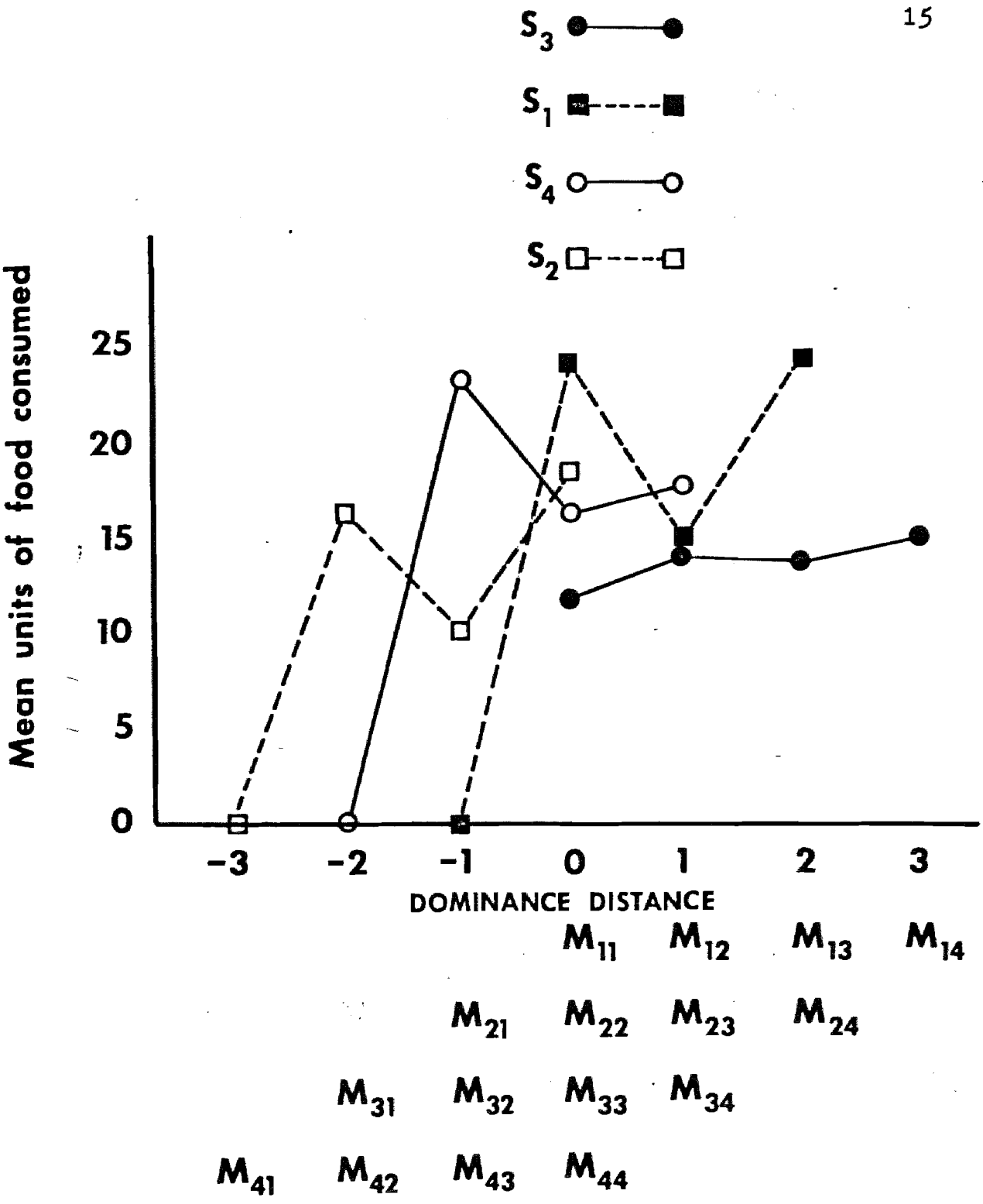

Figure 1. Mean units of food consumed by each S_i at each level of dominance-distance for that S_i and M_{ij} for each S_i.

$$\bar{X}_{.1} = \frac{M_{11} + M_{21} + M_{31} + M_{41}}{4}$$

$$\bar{X}_{.2} = \frac{M_{12} + M_{22} + M_{32} + M_{42}}{4}$$

$$\bar{X}_{.3} = \frac{M_{13} + M_{23} + M_{33} + M_{43}}{4}$$

$$\bar{X}_{.4} = \frac{M_{14} + M_{24} + M_{34} + M_{44}}{4}$$

Figure 2 shows the respective values of $\bar{X}_{.1}$, $\bar{X}_{.2}$, $\bar{X}_{.3}$, and $\bar{X}_{.4}$, which were derived by the method indicated above.

The null hypothesis was tested that there was no significant difference in food consumption as a function of dominance-distance, or $\mu_{.1} = \mu_{.2} = \mu_{.3} = \mu_{.4}$. A two-factor repeated measures analysis of variance revealed that there were no significant differences among these means as indicated in Table III.

TABLE II

UNITS OF FOOD CONSUMED BY EACH SUBJECT
DURING THE EXPERIMENTAL PHASE

Trial	Fed in Pairs		Fed Alone	
	Cage # (S)	½ Cups Eaten	Cage # (S)	½ Cups Eaten
1	3	14	2	15
	1	0	4	19
2	4	20	2	18
	1	0	3	10
3	3	13	1	19
	4	0	2	14
4	2	8	1	20
	4	17	3	12
5	2	20	3	11
	1	0	4	21
6	3	16	1	22
	2	0	4	15
7	4	14	1	32
	2	22	3	13
8	3	19	1	27
	2	0	4	16
9	3	17	2	24
	1	0	4	15
10	3	10	1	25
	2	0	4	15
11	4	22	1	20
	2	0	3	10
12	1	36	3	12
	2	28	4	20
13	3	12	2	25
	1	0	4	17
14	3	15	1	31
	4	0	2	24
15	1	10	2	26
	4	24	3	13
16	1	37	3	11
	2	0	4	12
17	1	36	2	17
	4	26	3	14
18	3	14	1	25
	4	0	2	7

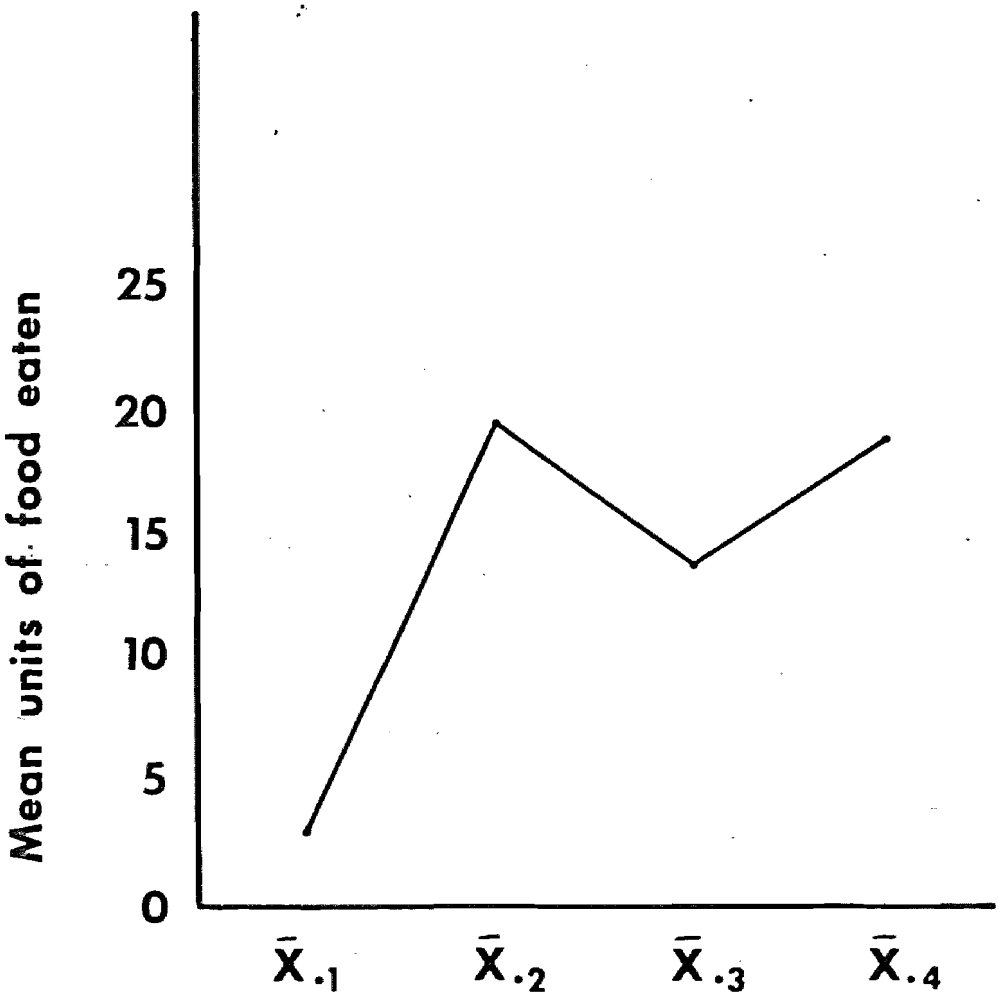

Figure 2. Mean units of food consumed at M_{ij} levels.

TABLE III

ANALYSIS OF VARIANCE SUMMARY TABLE

Source	df	SS	MS	F	p
Order of Dominance Distance	3	2133.01	711.00	2.50	$p > .05$
Observation Order	2	262.29	131.15	0.46	$p > .05$
Subjects	3	145.13	48.38	.17	$p > .05$
Dominance-distance X Observation Order	6	276.31	46.12	.16	$p > .05$
Dominance-distance X Subjects	9	617.48	68.61	.24	$p > .05$
Observation Order X Subjects	6	992.46	165.41	.58	$p > .05$
Dominance-distance X Observation Order X Subjects	18	901.90	50.11	.18	$p > .05$
TOTAL	47	5328.58			

Chapter 4

DISCUSSION

Results at the $.05 < p < .10$ level were obtained for the order of dominance distance suggesting a slight trend in the direction of the expected outcome. Positive results would have suggested that dominance-distance is an important factor in food getting behavior although further research would be needed to clarify the relationships between social closeness and other behaviors. Denny and Ratner (1970) list several variables which affect the behavior of subjects in a dominance hierarchy but do not mention dominance-distance as one of the variables.

A positive correlation between dominance-distance and other behavior, especially antagonistic behavior, may help to explain increased aggressiveness in overcrowded environmental conditions, a phenomenon reported by Van Kreveld (1970) and Marler and Hamilton (1966). The concept of dominance-distance used in this study was ordinal and linear. It would seem reasonable to assume, however, that the dominance-distance between two subjects could be diminished and, if the general hypothesis of this study is valid, that more conflict would occur between these two subjects as the dominance-distance decreased. Crowded living conditions might serve to decrease dominance-distance. To test this hypothesis, attention would need to be given to not only the total frequency

of conflict but also to the conflict displayed by the individual members involved.

The absence of significant results in this study may be due to variables unrelated to the postulated relationship between dominance-distance and food-getting behavior. These variables fall into two broad categories: Those related to displaying dominance behavior and those related to methodological problems. In the first category there were several unknown and perhaps important variables such as the genetic composition of the subjects, prior social experience, especially dominance relationships, severing the subjects' vocal cords, and using a slightly different experimental procedure for S_1 than for the rest of the subjects. Methodologically, the effects of a one-way mirror in the experimental chamber were not assessed. Also, during the experimental phase some subjects underwent occasional complete or partial food-deprivation while other subjects did not.

The breed-background of the subjects was completely unknown. Even a casual observer recognizes differences in temperament between different breeds of dogs. James (1951), working with terriers and beagles, found that the beagles, which were much less aggressive, would avoid contact with the terriers. Thus, since dogs in this study were of mixed breeds, genetic differences may have contributed greatly to the failure to detect etc.

Prior social experience was also unknown. Presumably, this was an important factor in S_1's increased frequency of assertive behavior as the experiment progressed. At the start of the study S_1 exhibited behavior strongly suggestive of conditioned anxiety, as evidenced by standing erect and rigid in her home cage when the experimenter was present and she would alternately cower and snap at the experimenter when her cage door was opened to deliver food and water. When in a group with the other subjects, S_1 would avoid contact with them. As the experiment progressed, S_1 became more assertive and elevated her status in the process. S_1 was the only subject, however, that was maintained overnight in the experimental chamber. Her changed behavior could be plausibly explained by hypothesizing a desensitization effect as the environment became less aversive. On the other hand, leaving S_1 in the experimental chamber may have resulted in her establishing the chamber as her territory.

Sectioning the subjects' vocal cords may have interfered with some or all of the subjects asserting dominance. James (1936) points out that usually a snarl or growl would intimidate the shy dogs in a research project he conducted.

Motivational variables further confounded the results of this study. Each subject that was paired with S_3 was denied access to food during that session. Also, other submissive subjects were denied either full access or partial access to food when paired with a dominant member. This

resulted in several subjects not eating for 48 hours. While Cackler (1970) found that changing motivational levels in dogs did not alter their previously established dominance-submission relationship, the role of hunger in food-getting situations would seem, nonetheless, to be an important variable to control. Cackler cautions against premature generalization as there were only two subjects in her study.

The use of a one-way mirror in the experimental chamber may have resulted in the subjects acting as if their reflections were other subjects. This would have been problematic as the effects of the one-way mirror were unknown.

The methodological problems in this study would need to be eliminated to obtain unequivocal results. Important controls for subsequent research would include the use of identical breeds or strains that had been reared in a controlled environment. Furthermore, motivational variables would be easily controlled by allowing the subjects to feed to satiation after the trial sessions were conducted.

The observational reports indicate that dominance-distance is a variable influencing social behavior in a number of species. Further research needs to be done to understand its effects.

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